(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 May 2002 (16.05.2002)

PCT

(10) International Publication Number
WO 02/39756 A1

(51) International Patent Classification[7]: H04Q 1/14

(21) International Application Number: PCT/US00/30961

(22) International Filing Date:
9 November 2000 (09.11.2000)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **TELECT, INC.** [US/US]; P.O. Box 665, Liberty Lake, WA 99019-0665 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **MAYBERRY, Terry, R.** [US/US]; 15912 E. Radio Drive, Veradale, WA 99037 (US). **TURPIN, Timothy, McBrien** [US/US]; 1115 N. Madson, Liberty Lake, WA 99019 (US). **ASHLEY, Jason** [US/US]; 4936 N. Pasadena Lane #95, Spokane, WA 99212 (US).

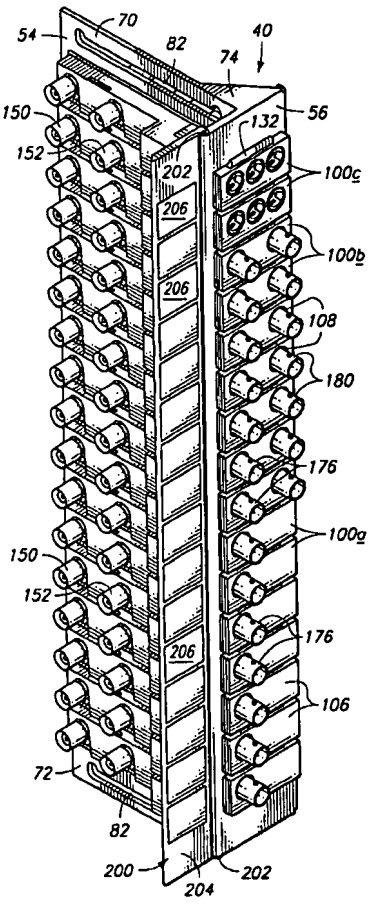
(74) Agents: **MATKIN, Mark, S.** et al.; Wells, St. John, Roberts, Gregory & Matkin, 601 West First Avenue, Suite 1300, Spokane, WA 99201-3828 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian

[Continued on next page]

(54) Title: RETROFIT PATCH AND/OR TEST PANEL



(57) Abstract: A preferred embodiment of a telecommunication coaxial patch patch and/or test panel (40) is described for mounting in a vertical orientation rask (10) for providing termination and front access for monitoring, testing and/or patching telecommunication signals between numerous telecommunication network elements (42, 48). The panel (40) has an open framework (54) with a front face element (56) have aaa plurality of horizontal openings (58) therein for receiving a vertical column of modules (100a, 100b or 100c) or a combination thereon. The modules (100) have at a miniumum a front access monitor connector (176) for monitoring an input digital signals transmitted between the. Each module (100) have a rear male input coaxial cable connectors (150) and rear male output coaxial cable connectors (152) mounted on the printed circuit board (80) and projecting horizontally outward from a reduced left-side of the modules. Each module has arear female input coaxial cable connectors (162) and a rear female output coaxial cable connectors (162) mounted on the printed circuit board and projecting horizontally outward from a reduced right-side of the module. Ther rear connectors (150, 152, 160 and 162) are longitudinally staggered and latteraly overlapping to reduce the width of the rear section of the module. The panel (40) has a module idendification wing (200) pivotally mounted thereon for movement between an out-of-the-way position and a viewing position.

WO 02/39756 A1

patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:

— *with international search report*

RETROFIT PATCH AND/OR TEST PANEL

Technical Field

This invention relates to retrofit patch and/or test panels for replacing termination panels in existing intermediate, digital telecommunication, coaxial cable, distribution racks to up-grade terminating, monitoring, testing and/or patching of central telecommunication network circuits.

Background Art

A large number of central office telecommunication facilities particularly those in developing countries have rows of side-by-side columns of termination panel racks with each rack having a number of vertically spaced, vertically oriented panels with termination coaxial cable connectors for terminating and interconnecting telecommunication network elements.

Such vertically oriented panels do not provide high density, reliable, front access for monitoring, testing and/or patching. Attempts have been made in the past to provide retrofit panels to up-grade such facilities, but with limited success. Either such previous attempts produced panels that were too expensive or were too large to be easily installed and operated.

One of the principal objects and advantages of this invention is to provide improved retrofit panels that are smaller, less costly, more adaptable, and easier to install and operate on the presently available racks, without compromising greatly improved performance.

These and other features and advantages of this invention will become apparent upon reviewing the following description of a preferred embodiment in conjunction with the drawings.

Brief Description of the Drawings

Preferred embodiments of the invention are described below with reference to the following accompanying drawings:

Fig. 1 is an isometric view of a bank of existing laterally spaced columns of intermediate telecommunication coaxial cable distribution racks, each rack having a

number of existing termination panels mounted thereon for terminating a plurality of telecommunication networks;

Fig. 2 is an isometric view of the bank of existing laterally spaced columns of intermediate telecommunication coaxial cable distribution racks, with the existing termination panels being replaced with retrofit panels that are the subject of the present invention for terminating, monitoring, testing and/or patching the plurality of telecommunication networks;

Fig. 3 is an isometric view of a preferred embodiment of this invention illustrating a single retrofit panel for mounting on one of the racks having a plurality of (1) mono-monitoring modules, (2) dual-monitoring modules, and (3) digital cross-connect and monitoring modules installed in a panel frame;

Fig. 4 is an isometric view similar to Fig. 3 except showing the panel frame being empty of modules except for one dual-monitoring module being installed on the panel frame and showing an identification wing in a viewing position in solid line and in an out-of-the-way position in doted line;

Fig. 5 is a fragmentary left side elevational view of the panel illustrated in Fig. 3 showing coaxial male termination connectors for terminating coaxial cables of one of the telecommunication networks;

Fig. 6 is a fragmentary right side elevational view of the panel illustrated in Fig. 3 showing coaxial female termination connectors for terminating coaxial cables of another of the telecommunication networks;

Fig. 7 is a top view of the digital cross-connect module illustrated in Fig. 3;

Fig. 8 is a bottom view of the module illustrated in Fig. 7 showing a module printed circuit board serving as a bottom wall of the module;

Fig. 9 is an isometric view of the module illustrated in Fig. 7 except with a module housing removed showing coaxial front jacks and coaxial male and female connectors mounted on the module printed circuit board;

Fig. 10 is an electrical schematic of electrical circuits of one of the mon-monitoring modules illustrated in Fig. 3;

Fig 11 is an electrical schematic of electrical circuits of one of the dual-monitoring module illustrated in Fig. 3;

Fig. 12 is an electrical schematic of electrical circuits of one of the digital cross-connect modules illustrated in Fig. 3;

Fig. 13 is a fragmentary side elevational view of a panel mounted on a rack with the panel being secured to the rack with the panel being in a retracted position;

Fig. 14 is a fragmentary side elevational view of the panel shown in Fig. 13 except showing the panel mounted to the rack with the panel being in an extended position forward of the rack to facilitate installation and repair; and

Fig. 15 is a vertical cross-sectional view taken along line 15-15 in Fig. 14 showing a locking mechanism in the form of a bolt and thumb nut for locking the panel in place.

Best Modes for Carrying Out the Invention and Disclosure of Invention

A preferred embodiment of the invention is described below with reference to the to above referenced drawings.

Fig. 1 illustrates an existing bank of elongated, telecommunication central office, racks 10 that are laterally spaced and vertically oriented into adjacent columns; each rack 10 having a plurality of existing vertically spaced elongated termination panels 12. The racks 10 are narrowly spaced horizontally from each other providing very limited space for a telecommunication worker to attach or disconnect coaxial cables to termination connectors (not shown) at the sides of the panels 12. Generally the racks are spaced approximately 12 to 15 c.m. center-to-center.

Each of the existing racks 10 has a generally U-shaped horizontal cross-section with a back wall 14 and sidewalls 16 and 18. Vertical slots 20 are formed in the back wall 14 at vertically spaced intervals to permit the passage of coaxial cables for termination at the panels 12.

Each of the existing racks 10 has support brackets 22 mounted thereon for supporting panel support frames 24. Each frame 24 has (1) an upper forward projecting panel support arm 26, (2) a lower forward projecting panel support arm 28, and (3) intermediate cable support arms 30 . Each of the panel support arms have bolt apertures 32 (Fig. 15) for receiving fastening bolts to fasten the panels 12 to the racks 10 using a tool. Because of the limited space between the racks 10, special hand tools are generally required to mount the panels 12 on the racks 10.

Each of the existing panels 12 have a front panel 34 for placing identification indicia thereon and a termination bulkhead 36 that extends rearward of the front panel. The termination bulkhead carries coaxial termination cable connectors (not shown) thereon for terminating and interconnecting telecommunication networks.

Fig. 2 illustrates a bank of racks 10 in which the panels 12 have been replaced with retrofit or replacement digital telecommunication patch and/test panels 40 of the preferred embodiment of the present invention. Each panel 40 is designed to provide

high density termination capability for a plurality of telecommunication coaxial network elements. Furthermore each panel 40 is designed to provide high density front access for monitoring, testing and/or patching those telecommunication electrical signals carried or generated by the telecommunication coaxial network elements; two representative network elements are identified with numerals 42 and 48 in Fig. 10-12.. Network element 42 has an "in" coaxial cable 44 and an "out" coaxial cable 46. Network element 48 has an "in" coaxial cable 50 and an "out" coaxial cable 52.

Each panel 40 (Figs. 3 and 4) has a rather open panel framework 54 that is mounted vertically on the rack 10, between panel support arms 26 and 28 (Figs. 13 and 14). The panel framework 54 has an elongated front face element 56, which in turn has a plurality of horizontally elongated module openings 58 formed therein one above the other forming a column of module openings 58. Each opening 58 has side edges 60 and 62, a top edge 64 and a bottom edge 66. The top edge 64 serves as a detent latch surface.

Each panel framework 54 has a bulkhead 68 that preferably is oriented along a front-to-back central plane of the panel 40 and extends rearward substantially perpendicular to the front face element 56 substantially midway between sides of the front face element 56 to form a substantially "T" shaped horizontal cross-section with the front face element 56. Gussets 74 extend between the bulkhead 68 and the front face element 56 to provide strength and relative rigidity to the front face element 56.

The bulkhead 68 (Fig. 3) has an upper flange end 70 and a lower flange end 72 for attaching the panel 40 to the upper and lower panel support arms 26 and 28 respectively.

The bulkhead 68 (Fig. 3) has a plurality of slots 76 formed therein in open communication with corresponding horizontal module openings 58 to define and form a plurality of vertically spaced module receiving compartments or cavities. The slots 76 extend from the openings 58 to rear ends 78. The bulkhead 68 has horizontal ribs 80 extending from the rear ends 78 to the front face element 56 in which each rib 80 has a lower edge that extends partially into a corresponding slot 76 to form part of an module alignment guide.

Both the upper flange end 70 and the lower flange end 72 have complementary mounting slots 82 (Figs. 5 and 6) formed therein for enabling the panel 40 to be moved between a forward projecting position (Fig. 14) in which the front face element 58 is forward of adjacent panels 40 and a rearward retracted position (Fig. 13) in which the front face element 58 is substantially flush with adjacent panel front face elements 58.

Each of the mounting slots 82 has an elongated horizontal slot section 84 extending from adjacent the front face element 58 to adjacent the rear end 78 to accommodate the movement between the positions. Each of the mounting slots 82 have end upward extending notches 86 and 88 formed at ends thereof constituting part of a latching mechanism to enable the panel 40 to be moved slightly downward relative to the panel support arms 26 and 28 to latch the panel 40 in either of the respective extreme positions.

A hand manipulated fastener 90 (Fig. 15) is provided in cooperation with the slot 82 to lock the latched panel 40 in either of the two positions. Preferably the fastener 90 comprises a threaded bolt 92 having a threaded shaft 93 and an enlarged bolt head 94. The bolt shaft 93 extends through the bolt aperture 32 of a panel support arm 26 or 28 with the bolt head 94 engaging one side of the arm 26 or 28. An enlarged finger-operated bolt nut 96 is mounted to the free end of the shaft 93 and is tightened or loosened by the fingers of a telecommunication technician to lock and unlock the panel 40 when the panel is one of the latched positions. Such a feature enables the telecommunication technicianr to quickly and efficiently install, remove or slide the retrofit panel 40 between the two extreme positions without having to use specialize tools in very tight quarters. Specialize tools are frequently lost or misplaced.

Importantly the panel 40 has a plurality of front access patch and/ test modules 100. The modules 100 may be in the form of (1) digital mon-monitor front access modules 100a, (2) digital dual-monitor front access modules 100b, or (3) digital front access cross-connect modules 100c or a combination thereof as shown in Fig. 3. Each of the module 100 provides coaxial termination and rear cross-connect capability for two coaxial telecommunication networks 42 and 48. Further each of the modules 100 provide, at a minimum, front access monitoring and testing capability for monitoring and testing at least one of the signals being transmitted between the interconnected networks 42 and 48. As illustrated in the electrical schematic of Fig. 10, the mon-monitor module 100a provides front access for monitoring and/or testing of the "in" signal being transmitted between the networks 42 and 48. As illustrated in Fig. 11, the dual-monitor 100b provides front access for monitoring and /or testing either the "in" or "out" signals or both being transmitted between the networks 42 and 48. As illustrated in Fig. 12, the front cross-connect module 100c provides not only front access monitoring of the "in" signal but also front cross-connect patch capability of either the "in" or "out" signal or both.

Each module 100 is removably mounted in a corresponding module receiving compartment defined by a corresponding opening 58 and slot or cavity 76. It should be understood that almost invariably the telecommunication technician will mount or inert more than one module 100 in each panel 40 with most of the panels 40 being full (preferably sixteen modules 100 in each panel 40). However in some instances the technician may desire unused capacity to service additional telecommunication network in the future. Thus during certain time periods some of the panels 40 may be partially full. One of the advantages of this invention is to be able to easily add or subtract modules 40 as circumstances dictate. Furthermore if modules in one panel 40 are unused then the modules 100 may be easily removed and inserted in other panels 40. Consequently the telecommunication technician may first install the panels 40 and then wait to purchase additional modules 100 until the need arises, thus reducing inventory costs.

Each module 100 has a housing 104 (Figs 5-8) that includes an elongated horizontal front wall 106 with one or more front wall apertures 108 (Fig. 3) for receiving front access connectors. Elongated side walls 110 and 112 extend rearward along a longitudinal axis "A" from the front wall 106 to a rear section 114. The side walls 110 and 112 have side indentations 115 formed therein adjacent the housing rear section 114. The side walls 110 and 112 have offset horizontal openings formed therein adjacent the rear section 114 and within the indentations 115. The housing 104 includes a top wall 118 that extends from the front wall 106 rearward to the rear section 114 terminating at a back wall 116. An elongated alignment groove 120 is formed in the top wall 118 for receiving the lower surface of a rib 80 when the module 100 is inserted into a slot 76 top-side up. The rib 80 prevents a module 100 from being inserted into a slot 76 with the bottom-side up. Thus the elongated top grooves 120, in conjunction with ribs 80, form alignment guides for assuring that the modules 100 are mounted in the panel 40 in the proper orientation.

Additionally the rear wall 116 has a vertical groove 122 formed therein for receiving a rear end 78 of a bulkhead to hold the rear section 114 in place when the panel 40 is fully inserted into the slot 76 to prevent the rear section 114 from moving laterally with respect to the bulkhead 68 while the network coaxial connectors are being attached to the module.

Each module 100, preferably as part of the housing 104, has a releasable latch 126 (Fig. 7) that cooperates with the framework 54 to releasably secure the module 100 firmly in a respective slot 76 of a panel 40. The latch 126 has a resilient detent 128

on the top wall 118 for engaging a top edge 64 of an opening 58 when the module 100 is fully inserted into a slot 76 for releasably securing a module 100 firmly to the panel 40. Preferably the detent 128 is formed integral with the top wall 118 as a flexible lever that extends forward and slightly upward terminating in a tab 132. A cross slot 130 is formed in the lever to receive the top edge 64. The latch 126 is released by deflecting the tab 132 downward lowering the cross slot 130 sufficiently to clear the top edge 64. When the module 100 is fully inserted the flexible lever snaps upward bringing the top edge 64 into the cross slot 130. Thus the module installer can sense the "snap action" and be assured that the module 100 is securely mounted to the panel 40.

When a telecommunication technician wishes to remove a module 100, he/she merely deflects the tab 132 downward to lower the cross slot 130 from the top edge 64 and then pulls the module 100 from the slot 76 through the opening 58.

Each module 100 (Figs. 8 and 9) has an elongated printed circuit board 140 mounted to the housing 104 preferably forming a bottom housing wall. The printed circuit board 140 extends along the longitudinal axis "A" from the front wall 106 to the rear wall 116. The width of the printed circuit board 140 narrows at the rear section 114 of the housing 104. The side walls 110 and 112 have attachment tabs 124 formed thereon adjacent lower edges of the walls for securing the printed circuit board 140 to the housing 106 to serve as a bottom wall. The side walls 110 and 112 are sufficiently flexible to enable the printed circuit board 140 to be inserted into the housing deflecting the tabs 124 outward until the printed circuit board is fully inserted and the tabs snap inward securing the printed circuit board to the housing 106.

Each of modules 100 has a male "in" electrical coaxial connector 150 and a male "out" electrical coaxial connector 152 mounted on the printed circuit board 140 spaced along the longitudinal axis "A" in the indentation 115 and projecting laterally outward through openings in side wall 110. The connectors 150 and 152 connect to female connectors of an input coaxial cable and an output coaxial cable respectively that communicate with telecommunication network 42. Each of male coaxial connectors 150 and 152 (Fig. 9) has (1) a right-angle base section 154 affixed to the printed circuit board 140 and (2) a horizontally extending male coaxial cable. connector section 156 extending horizontally outward through the side wall 110 into the indentation 115 for connecting to the female connectors of coaxial cables of telecommunication network 42. The cable connecting sections 156 are at right-angles to the base section 154 and are preferably threaded for connecting to complementary threaded connectors of the coaxial cables.

Each of modules 100 has a female "in" electrical coaxial connector 160 and a female "out" electrical coaxial connector 162 mounted on the printed circuit board 140 and spaced along the longitudinal axis "A" and laterally overlapping with respect to the connectors 150 and 152 at the rear section 114. The connectors 160 and 162 face in opposite direction to the connectors 150 and 152 and project outward through openings in the side wall 112 into the indentation 115. The female connectors 160 and 162 are adapted to connect to the input and the output coaxial cables respectively that communicate with telecommunication network 48. Each of female coaxial connectors 160 and 162 have a right-angle base section 164 affixed to the printed circuit board 140 and a horizontally extending female coaxial cable connecting section 166 extending horizontally outward through the side wall 112 into the side wall indentation 115 for connecting to complementary male connectors of coaxial cables of telecommunication network 48. The cable connecting sections 166 are at right-angles to the base section 164 and are preferably threaded for connecting to complementary threaded male coaxial connectors of the network 48.

The connectors 150, 152, 160 and 162 are longitudinal spaced along the longitudinal axis "A" and are laterally overlapping each other. It should be noted that male connector 152 is located between the female connectors 160 and 162 and that female connector 160 is located between the male connectors 150 and 152. Alternatively the location of the connectors 150, 152, 160 and 162 may be rearranged along the longitudinal axis "A" as long as they lateral overlap each other to minimize the width of the rear section 114 of the module 100 to permit a telecommunication technician to more readily connect and disconnect the connectors using only his/her fingers.

Each module 100 has an input electrical circuit 170 (Figs.10-12) that normally directly interconnects the male input electrical connector 150 of telecommunication network 42 to the female input electrical connector 160 of telecommunication network 48 to transmit telecommunication digital signals there between to provide termination facilities. The circuit 170 is at least partially imprinted on the printed circuit board 140.

Each module 100 has an output electrical circuit 172 (Figs. 10-12) that normally directly interconnects the male output connector 152 of telecommunication network 42 with the female output electrical connector 162 of the telecommunication network to transmit telecommunication digital signals there between to provide termination facilities. The circuit 172 is at least partially imprinted on the printed circuit board 140.

Each module 100 has a front access input coaxial connector 176 that is mounted on the printed circuit board 140 and projects through an opening 108 in the housing

front wall 106. In the mon-monitor module 100a and the dual-monitor module 100b, the connector 176 is preferably in the form of a right-angle BNC coaxial connector. In module 100c, the connector 176 is the form of a right-angle coaxial jack connector. The connector 176 is electrically connected to the input circuit 170 through an isolation electrical resister 178 to enable a telecommunication technician to monitor or test the digital input signals of the networks 42 and 48 from the front face of the panel 40.

Each of the dual-monitor modules 100b has a second front access output monitor connector 180 mounted on the printed circuit board 140 that projects through a second opening 108 in the front module wall 106. Preferably the connector is in the form of a right-angle BNC coaxial connector. The connector 180 is electrically connected to the output circuit 172 through an isolation resister 182 to enable a telecommunication technician to monitor or test the digital output signals of the networks 42 and 48 from the front face of the panel 40.

Each of the digital cross-connect modules 100c has a front access cross-connect input coaxial jack connector 184 and a front access output coaxial jack connector 186 mounted on the printed circuit board 140 that project through openings 108 in the module front wall 106 to selectively receive coaxial jack plugs (not shown) to be inserted therein. Each of the coaxial jack connectors 184 and 186 (Figs. 9 and 12) has an elongated front barrel section 188 that extend forward from the printed circuit board 140 through the openings 108. Each of the coaxial jack connectors 184 and 186 has a base section 190 that extend at right-angles to the front barrel sections 188 having projecting terminals (not shown) affixed to the printed circuit board 140 and electrically connected to conductive traces on the printed circuit board. If the reader wishes more specific information concerning such mounting and electrical connection, reference is made by incorporation to the Hill et al US Patent 5,546,282 issued 13 August 1996. To keep this description reasonably concise it is not believe necessary to repeat the information here.

Each module 100c has an input jack switch 192 (Fig. 12) housed in the input jack connector 184 and electrically connected in the input electrical circuit 170. The input jack switch 192 is actuated by the insertion of a jack plug into the barrel section 188 to interrupt the connection between the male input electrical connector 150 and the female input electrical connector 160 and interconnect the input electrical connector 150 to the inserted jack plug for testing or patching.

Each module 100c has an output jack switch 194 housed in the output jack connector 186 and electrically connected in the output electrical circuit 172. The output

jack switch 194 is actuated by the insertion of a jack plug into the output jack connector 186 to interrupt the connection between the male output electrical connector 152 and the female output electrical connector 162 and interconnect the output electrical connector 152 to the inserted jack plug for testing or patching.

The panel 40 has a vertically elongated identification wing 200 (Figs. 3 and 4) mounted thereon at a side corner of the front face element 56 for pivotal movement about a substantially vertical axis between a viewing position (shown in solid in Fig 4) and an out-of-the-way position (shown in doted in Fig. 4). The identification wing 200 is supported on hinges 202 for enabling the wing to pivot between the viewing position in which the wing extends outward to the side of the panel face element to enable the telecommunication technician to readily read any indicia on the wing and the out-of-the-way position in which the wing is pivoted rearward along side the side wall 110 of the module housing. When the wing 200 is in the out-of-the-way position, the technician is free to move his/her hands between the panels to have finger access to the rear connectors 150, 152, 160 and 162.

The wing 200 has an indicia bearing surface 204 thereon to enable telecommunication indicia to placed on the surface 204 to individually identify a corresponding module 100 and/or the termination location (points) or the identities of the networks 42 and 48 that are terminated by the corresponding module 100. Preferably the surface 204 has a number of indicia areas 206 corresponding to the number of module slots 76 that are vertically spaced along the vertical length of the wing 200 for receiving indicia concerning the corresponding modules 100

The invention has been described in language more or less specific as to structural and methodical features. It is to be understood, however, that the invention is not limited to the specific features shown and described, since the means herein disclosed comprise preferred forms of putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the proper scope of the appended claims.

CLAIMS

1. A retrofit digital telecommunication patch and/or test panel for mounting on an existing intermediate digital telecommunication coaxial cable distribution rack for terminating at least two coaxial telecommunication network elements and for enabling front electrical patch and/or test access to signals from such coaxial network elements, comprising:

a panel framework mountable to the distribution rack in a substantially vertical orientation and having an elongated front face element with a plurality of vertically spaced elongated horizontal module openings therein forming a vertical column of openings;

a plurality of elongated patch and/or test modules mounted horizontally in the vertical column of module openings and extending rearward from the face element; each of the elongated patch and test modules having:

a. an elongated housing mounted in one of the openings;

b. said elongated housing having a horizontally elongated front wall and elongated side walls that extend rearward from the front wall to a rear portion of the housing along a longitudinal axis;

c. a printed circuit board mounted to the housing;

d. a front monitor coaxial jack mounted on the printed circuit board and projecting through a jack opening in the front wall for receiving a front access coaxial jack plug;

e. a first input coaxial cable connector mounted on the printed circuit board along the longitudinal housing axis adjacent the rear portion of the housing for connecting to a coaxial input cable from one of the network elements;

f. a second input coaxial cable connector mounted on the printed circuit board along the longitudinal housing axis adjacent the rear portion of the housing for connecting to a coaxial input cable from the other network element;

g. a first output coaxial cable connector mounted on the printed circuit board along the longitudinal housing axis adjacent the rear portion of the housing for connecting to a coaxial output cable from the one of the network elements;

h. a second output coaxial cable connector mounted on the printed circuit board along the longitudinal axis adjacent the rear portion of the housing for connection to a coaxial output cable of the other network element;

i. an input electrical circuit at least partially imprinted on the printed circuit board and extending electrically between the first and second input connectors;

j. an output electrical circuit at least partially imprinted on the printed circuit board and extending electrically between the first and second output connectors;

k. a monitoring circuit at least partially imprinted on the printed circuit board and operatively electrically connecting the monitor jack with either the input circuit or the output circuit; and

l. wherein the input connectors and the output connectors are longitudinal spaced along the housing axis and laterally overlapping to minimize the width of the rear portion of the housing.

2. The retrofit telecommunication patch and/or test panel as defined in claim1 further comprising an identification wing having areas thereon for receiving indicia thereon; and wherein the wing is movably mounted on the framework adjacent a front corner of the framework for movement between an out-of-the-way position along side the framework and a viewing position in which the identification wing extends outward from the framework to enable an operator to easily view the indicia on the identification wing.

3. The retrofit digital telecommunication patch and/or test panel as defined in claim 1 wherein each module further includes:

m. a front input coaxial jack mounted on the printed circuit board and projecting through a second jack opening in the front wall for receiving a front access coaxial jack plug;

n. a front output coaxial jack mounted on the printed circuit board and projecting a third jack opening in the front wall for receiving a front access coaxial jack plug;

o. an input jack switch mounted within the input jack and forming part of the input electrical circuit for normally electrically interconnecting the first and second input connectors when a jack plug is absent from the input

jack and for interrupting the electrical interconnection between the first and second input connectors when a jack plug is present in the input jack; and

q. an output jack switch mounted within the output jack and forming part of the output electrical circuit for normally electrically interconnecting the first and second output connectors when a jack plug is absent from the output jack and for interrupting the electrical interconnection between the first and second output connectors when a jack plug is present in the output jack.

4. The retrofit digital telecommunication patch and/or test panel as defined in claim 1 wherein each module further includes (1) a second front monitor coaxial jack mounted on the printed circuit board and projecting through a second jack opening in the front wall for receiving a front access coaxial jack plug; and (2) a second monitoring circuit at least partially imprinted on the printed circuit board and operatively connected to the between the second front monitor coaxial jack and to input circuit or the output circuit not connected to the first front monitor coaxial jack.

5. The retrofit digital telecommunication patch and/or test panel as defined in claim 1 wherein each of the connectors on the module is a right-angle connector having a cable connecting section extending horizontally laterally outward from the longitudinal housing axis and having a base section mounted to the printed circuit board at an approximately 90 degree orientation to the cable connecting section.

6. The retrofit digital telecommunication patch and/or test panel as defined in claim 1 wherein at least some of the module housings have longitudinal grooves formed therein and wherein the panel framework has longitudinal alignment guides formed thereon that project into the module openings to be received in the module housing grooves as the modules to facilitate mounting and alignment of the modules in the module openings.

7. The retrofit digital telecommunication patch and/or test panel as defined in claim 1 wherein each of the module openings has an upper edge on the front face element and wherein at least one of the modules has a detent on an upper wall of the module housing for engaging one of the upper edges of a module opening when the module is fully inserted to releaseable latch the module in the module opening.

8. The retrofit digital telecommunication patch and/or test panel as defined in claim 7 wherein the detent is formed integrally with the upper wall of the module housing.

9. The retrofit digital telecommunication patch and/or test panel as defined in claim 8 wherein each latch has releasing element projecting outward from the front face element opening for enabling the latch to readily released from the panel framework.

10. The retrofit digital telecommunication patch and/or test panel as defined in claim 1 wherein the panel framework has alignment guides operable between the panel framework and the modules for preventing the modules from being mounted upside down.

11. The retrofit digital telecommunication patch and/or test panel as defined in claim 1 wherein the printed circuit board serves substantially as a bottom housing wall and wherein the side housing walls have side flanges the engage and hold the printed circuit board in place.

12. The retrofit digital telecommunication patch and/or test panel as defined in claim 11 wherein the side walls are sufficiently resilient to enable the printed circuit to be inserted into the housing deflecting the side walls and the flanges outward until the printed circuit board is past the flanges enabling the flanges to snap inward to hold the printed circuit board in place.

13. The retrofit digital telecommunication patch and/or test panel as defined in claim 1 wherein the connectors are interlaced with one input connector spaced along the longitudinal axis between the two output connectors and with one output connector spaced along the longitudinal axis between the two input connectors.

14. The retrofit digital telecommunication patch and/or test panel as defined in claim 1 wherein the panel framework has an elongated upper track slot and an elongated lower track slot formed therein for enabling the panel to be moved horizontally between a normal operational position in which the panel is inserted into the rack with access to the connectors between two adjacent panels being inconvenient and a retracted position in which the panel extends from the rack with the connectors being exposed for easy access to enable a telecommunication worker to conveniently attach or disconnect the coaxial cables to or from the connectors.

15. The retrofit digital telecommunication patch and/or test panel as defined in claim 14 wherein the panel has a releaseable fastener that projects into at least one of the track slots for releaseably locking the panel in the normal operational position.

16. The retrofit digital telecommunication patch and/or test panel as defined in claim 14 wherein at least one of the track slots has vertical end slots communicating with the track slot at its ends for receiving a guide therein when the panel is in either the normal operational position or the retracted position for enabling the panel to be moved slightly vertical to latch the panel in that position.

17. The retrofit digital telecommunication patch and/or test panel as defined in claim 16 wherein vertical end slots are formed at the ends of the track slots for enabling the panel to be lifted slightly while in the normal operating position and then moved to the retracted position and then moved slightly downward to latch the panel in the retracted position.

18. The retrofit digital telecommunication patch and/or test panel as defined in claim 17 wherein the panel has a locking means for locking a latched panel in either the normal operational position or the retracted position.

19. The retrofit digital telecommunication patch and/or test panel as defined in claim 18 wherein the locking means includes a thumb bolt having a bolt section that extends through the slots interconnecting to the rack and a thumb section that may be easily griped by the fingers of the telecommunication work person to lock and unlock the panel in either of the two positions.

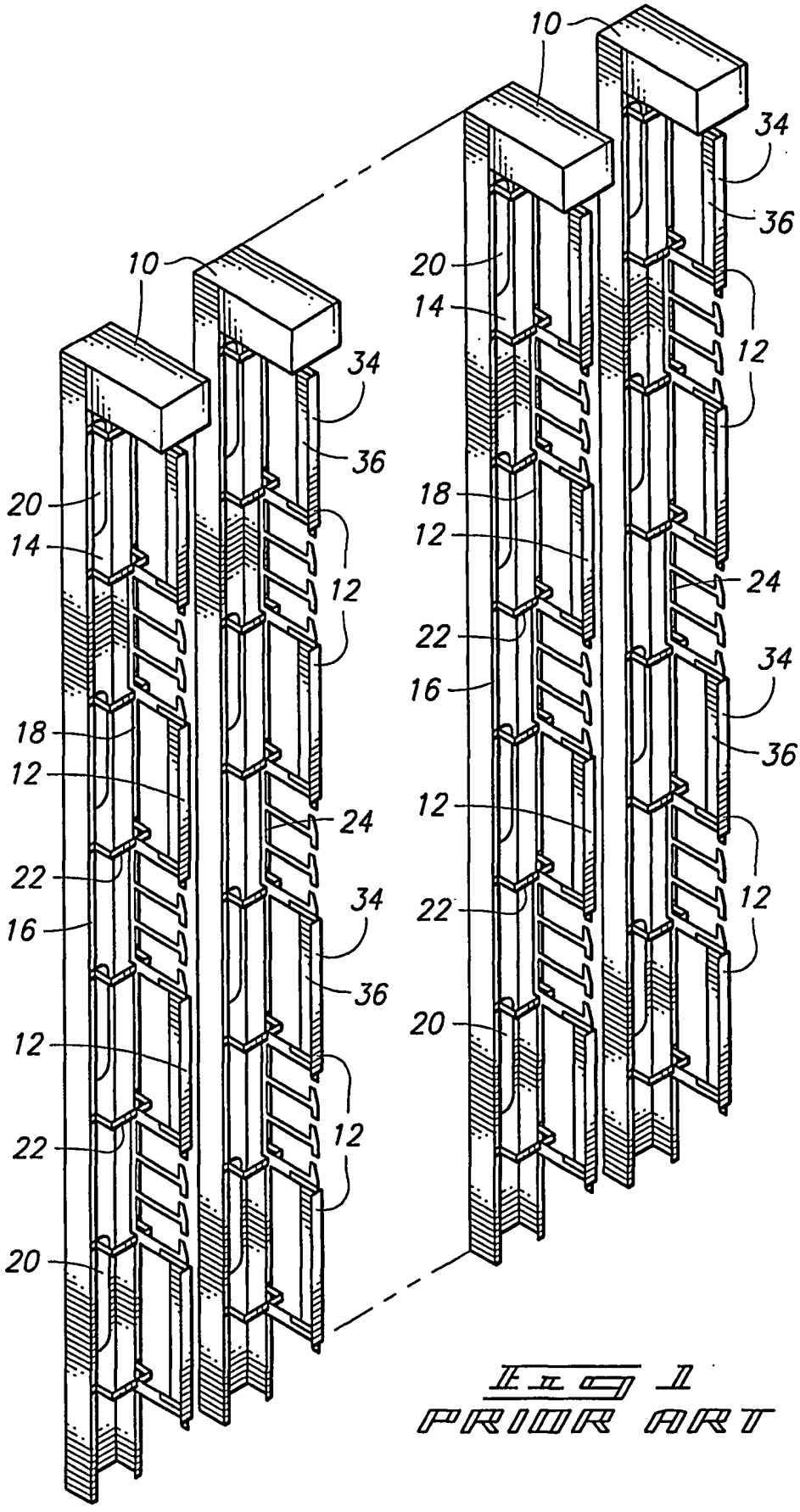


Fig 1
PRIOR ART

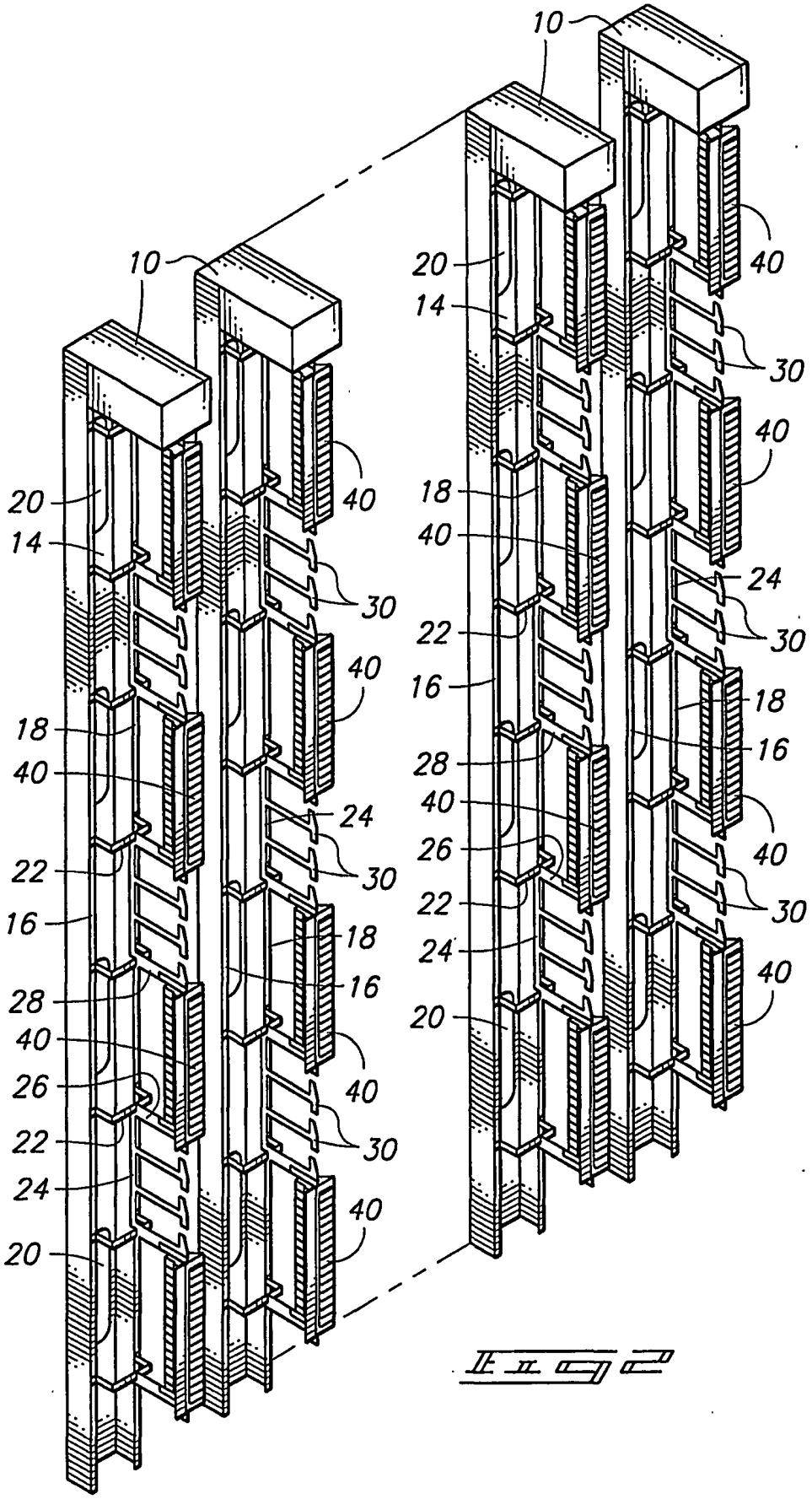

10
10
20
14
40
30
40
18
40
24
22
30
16
18
28
40
26
22
24
20
40
30
40
20
14
40
30
40
18
40
24
22
30
16
18
28
16
40
26
22
30
24
40
20
40
30
40
18
16
40
24
30
18
16
40
40
30
40
20

Fig 2

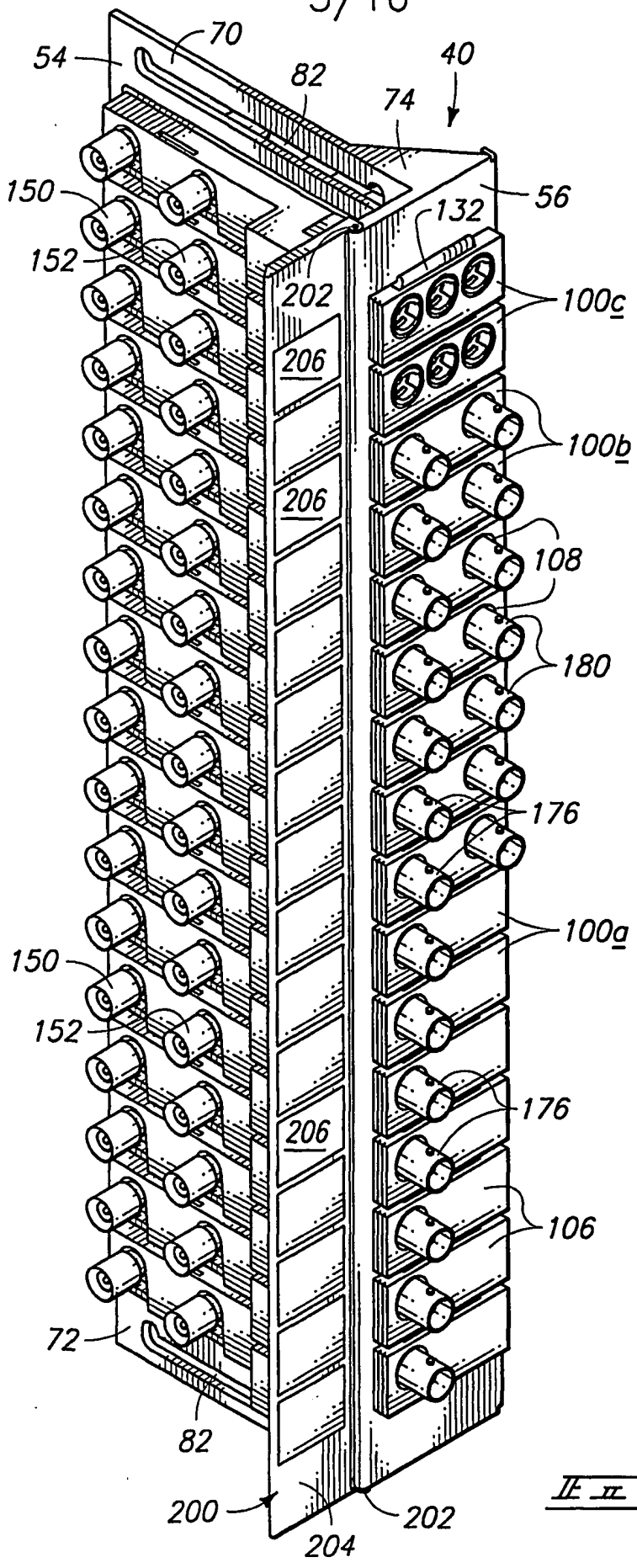

70
54
82
74
40
150
56
132
152
202
100c
206
100b
206
108
180
176
100a
150
152
206
176
106
72
82
200
202
204

Fig 3

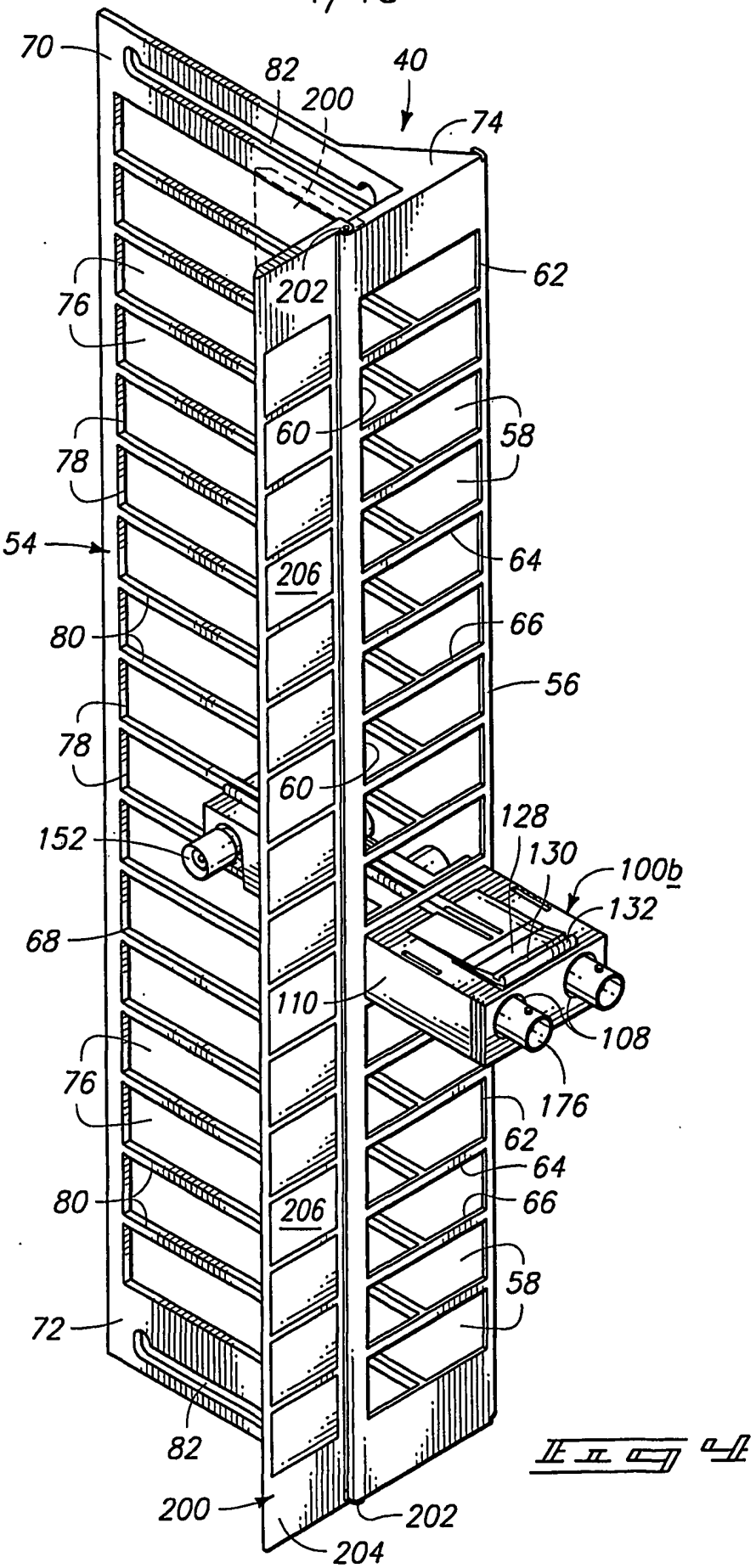

70
82
200
40
74
62
202
76
60
58
78
54
64
206
66
80
56
78
60
128
152
130
100b
132
68
110
108
76
176
62
64
80
206
66
58
72
82
200
202
204

Fig 4

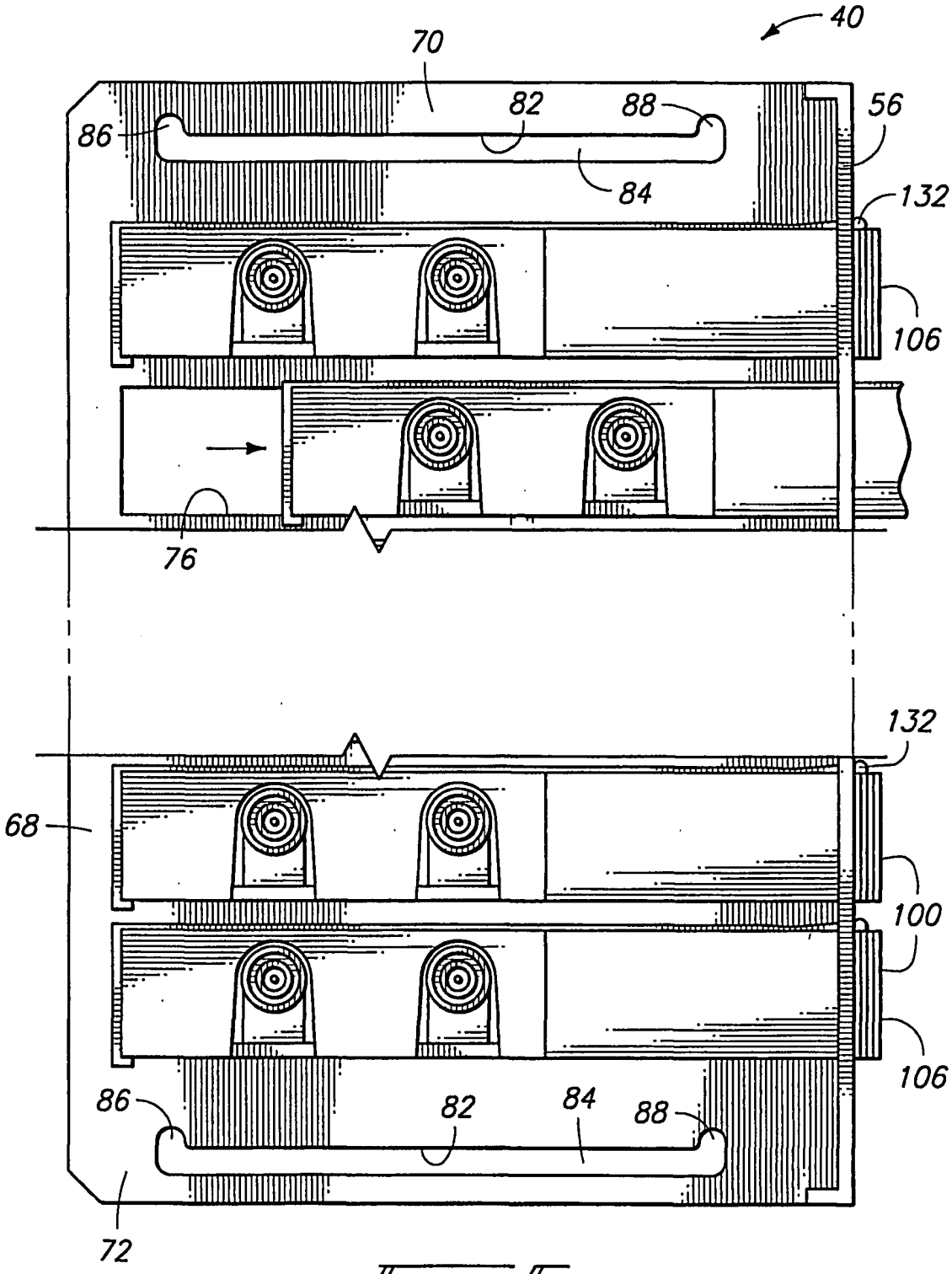


Fig 5

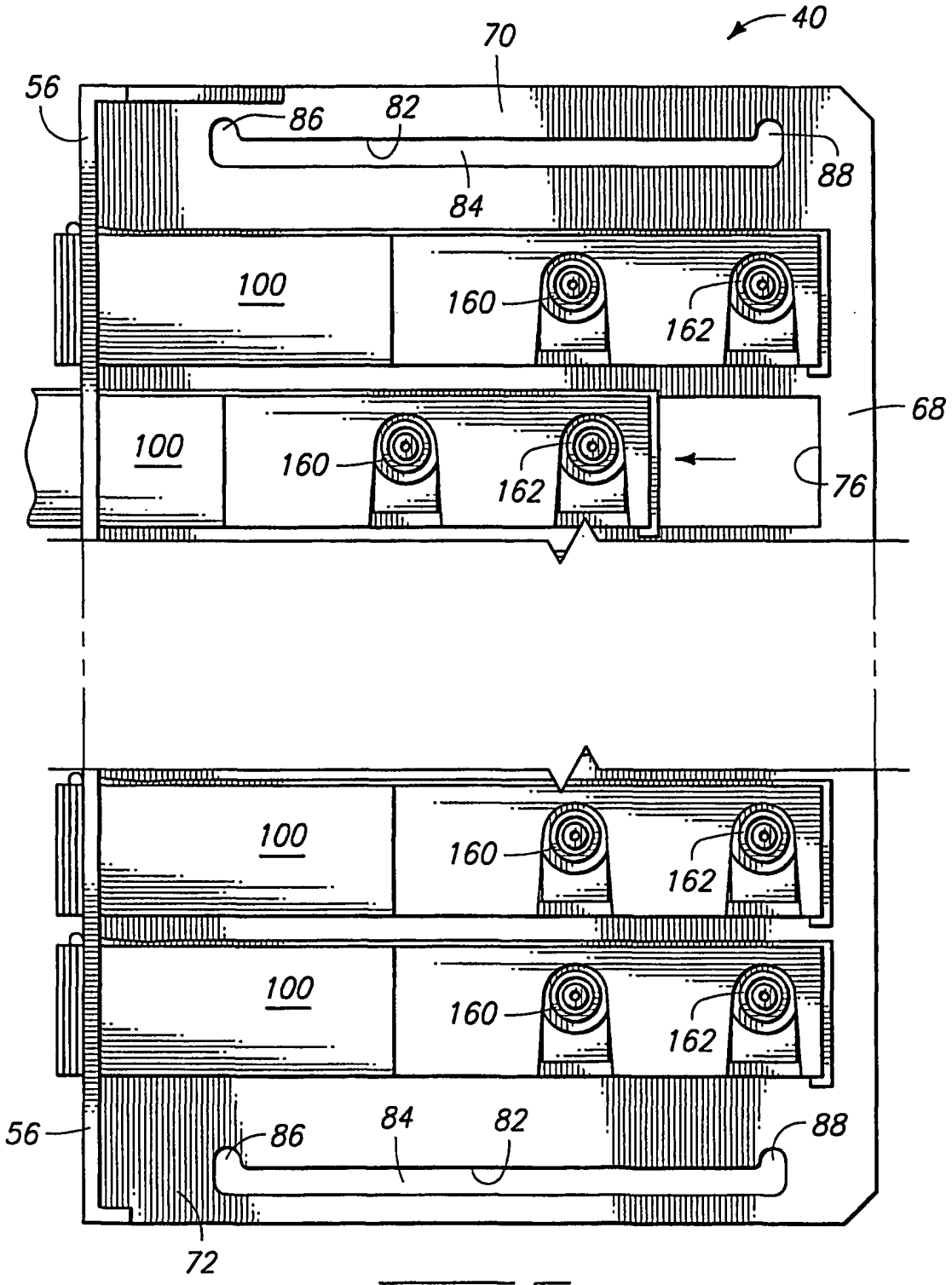

40
70
56
86
82
88
84
100
160
162
68
100
160
162
76
100
160
162
100
160
162
56
86
84
82
88
72

Fig 6

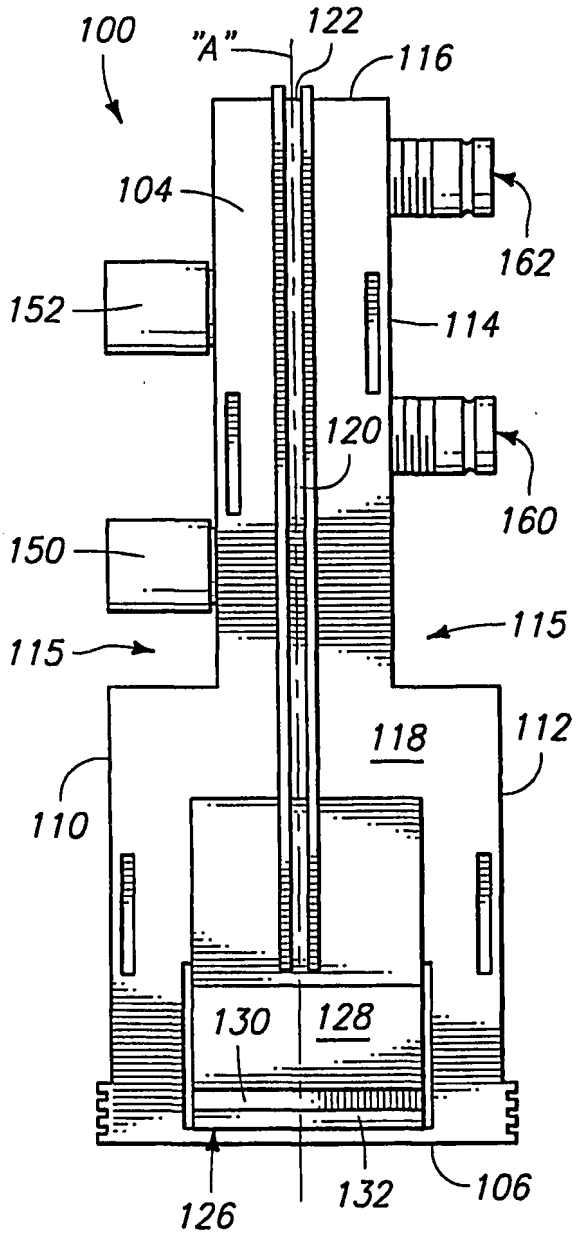

100
"A"
122
116
104
162
152
114
120
160
150
115
115
118
112
110
130
128
126
132
106

Fig 7

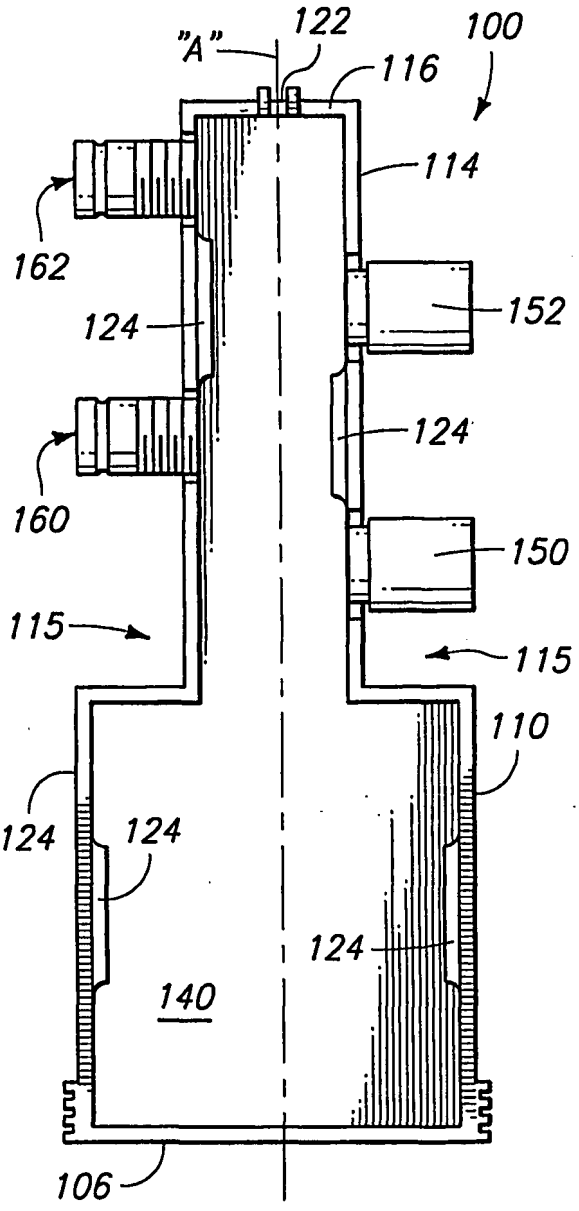

"A"
122
100
116
114
162
152
124
124
160
150
115
115
110
124
124
124
140
106

Fig 8

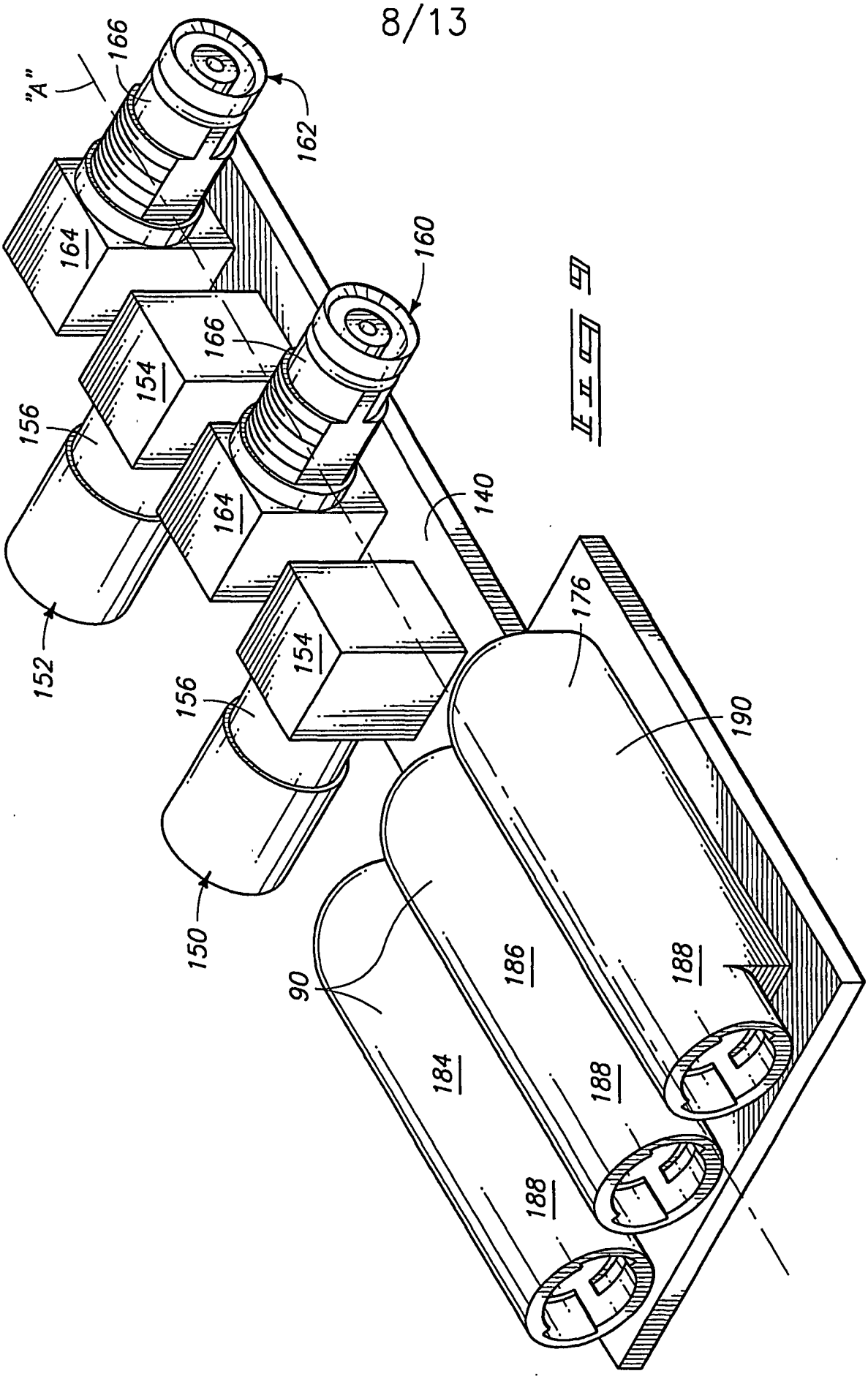

"A"
166
162
164
160
166
154
156
164
140
154
176
156
190
152
150
90
186
188
184
188
188

FIG 9

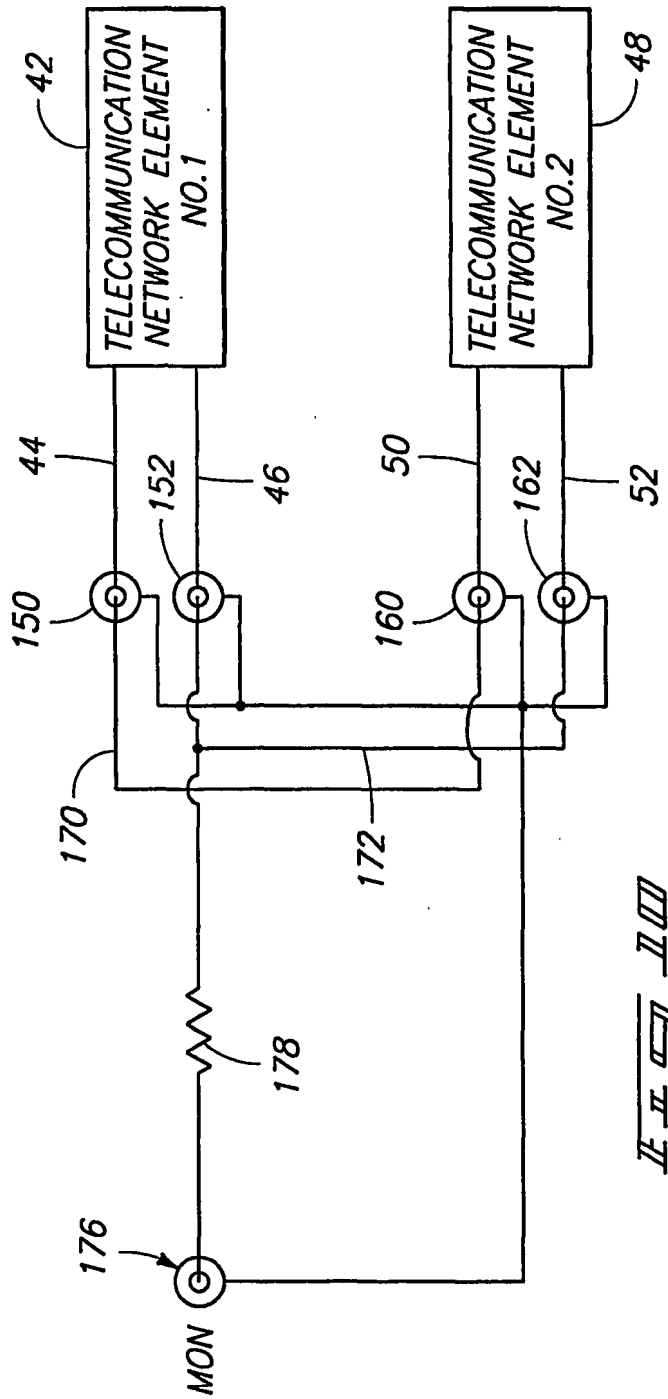

TELECOMMUNICATION NETWORK ELEMENT NO.1
TELECOMMUNICATION NETWORK ELEMENT NO.2
42
44
46
48
50
52
150
152
160
162
170
172
178
176
MON

FIG. 1

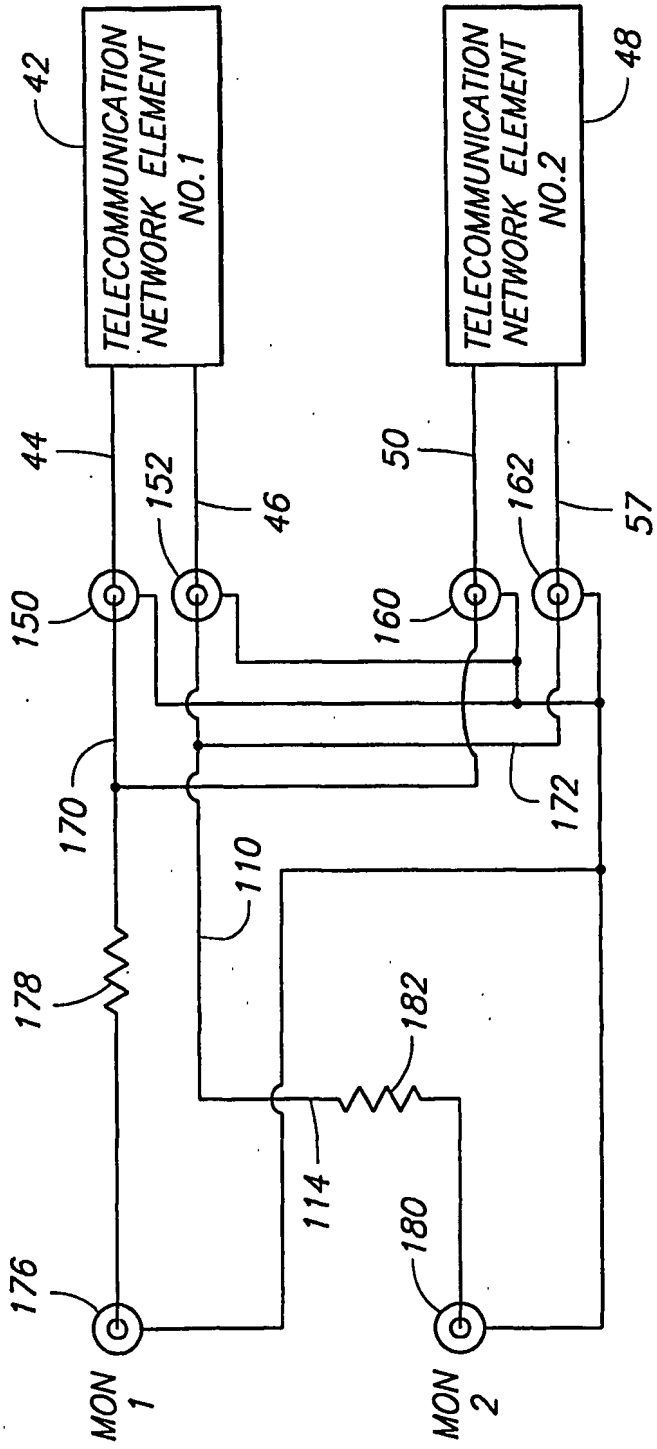

TELECOMMUNICATION NETWORK ELEMENT NO.1
TELECOMMUNICATION NETWORK ELEMENT NO.2
42
48
44
46
50
57
150
152
160
162
170
172
110
178
182
114
176
180
MON 1
MON 2

FIG. 11

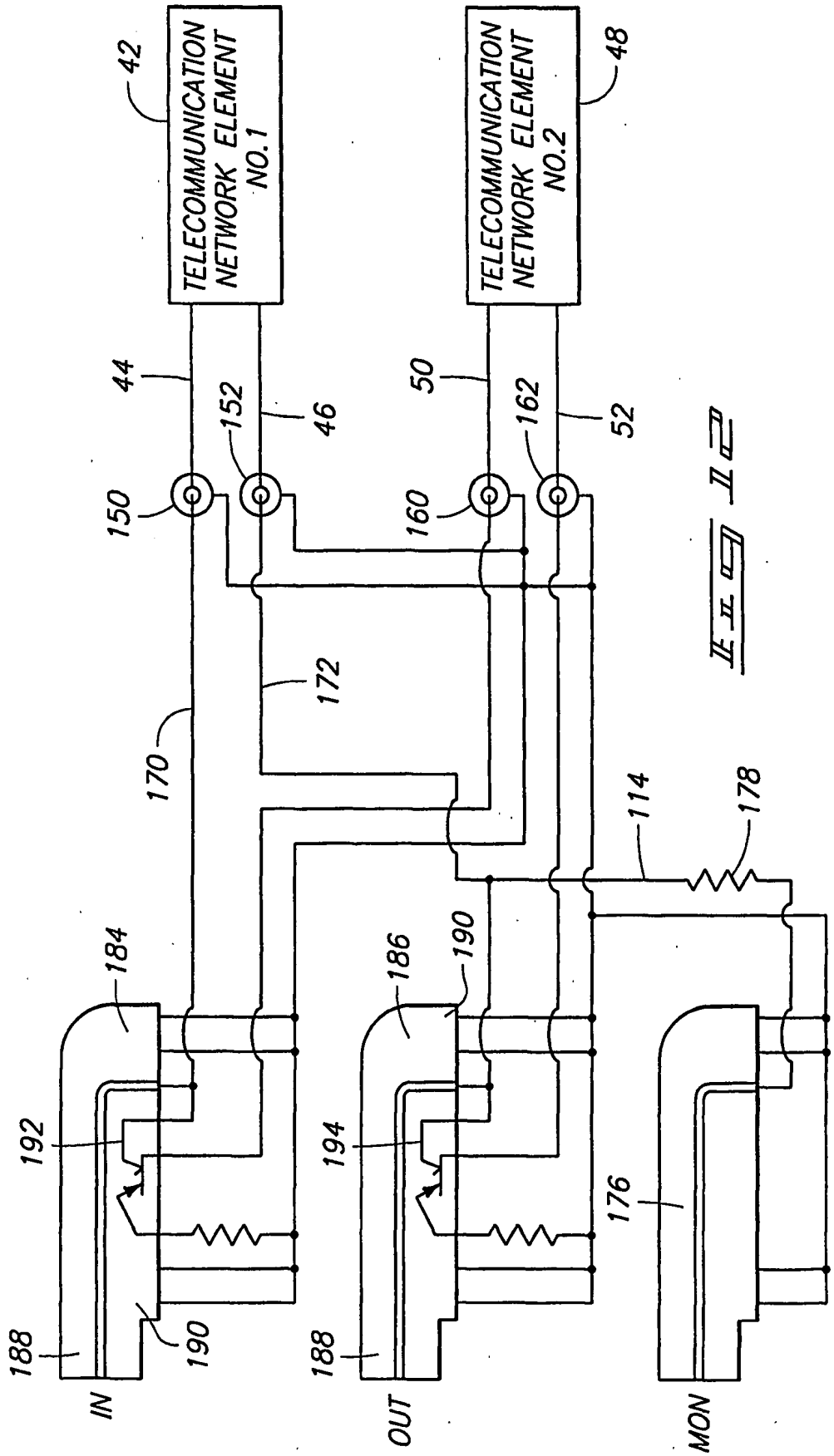

TELECOMMUNICATION NETWORK ELEMENT NO.1
TELECOMMUNICATION NETWORK ELEMENT NO.2
42
44
46
48
50
52
150
152
160
162
170
172
114
178
184
186
190
192
194
176
188
190
IN
OUT
MON

FIG 11

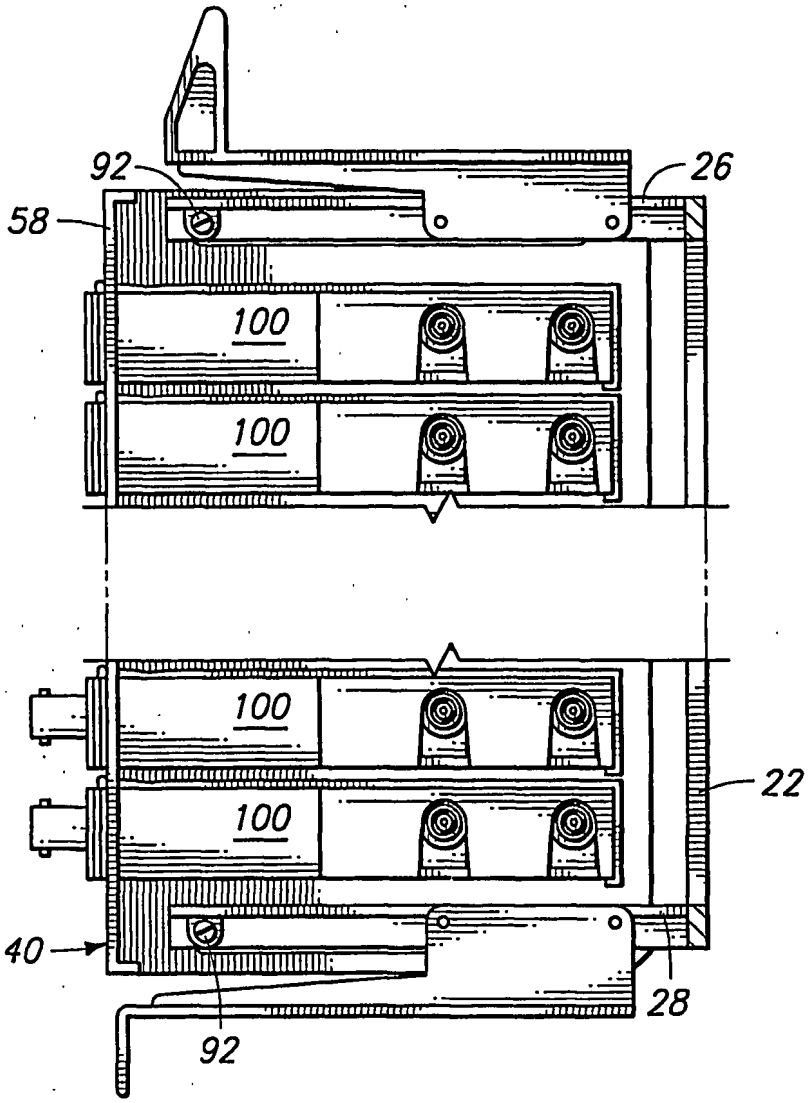


Fig 13

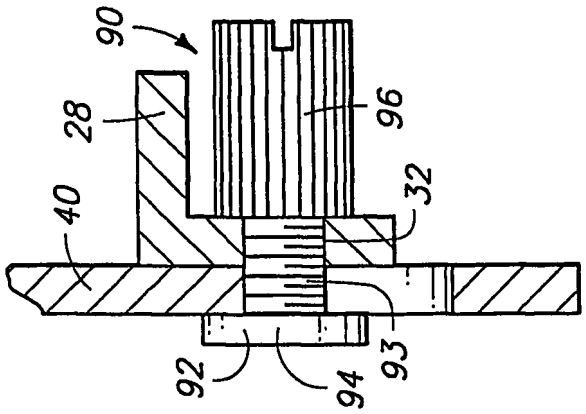


Fig. 11

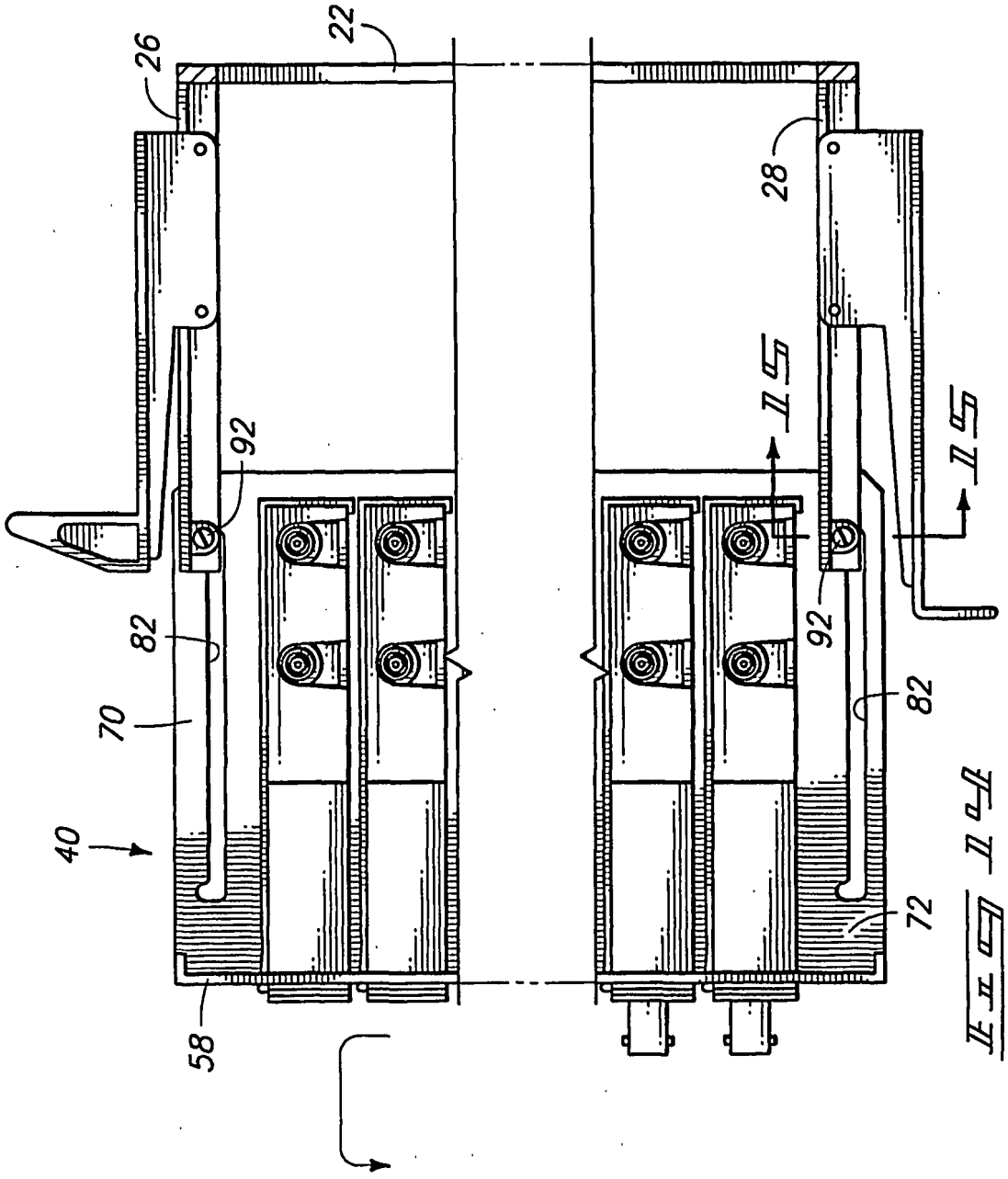


Fig. 10

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/30961

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q1/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 885 112 A (EMANI SASTRY V ET AL) 23 March 1999 (1999-03-23) column 1, line 31 - line 4; figures 1,2	1
A	US 5 546 282 A (ALLEN BRIAN J ET AL) 13 August 1996 (1996-08-13)	
A	EP 0 330 765 A (TELECT INC) 6 September 1989 (1989-09-06)	
A	US 5 233 501 A (SKINFILL DONALD R ET AL) 3 August 1993 (1993-08-03)	
A	WO 96 38884 A (TELECT INC ;HILL TIMOTHY L (US)) 5 December 1996 (1996-12-05)	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 August 2001	14/08/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Vandevenne, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Ir onal Application No
PCT/US 00/30961

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5885112 A	23-03-1999	NONE	
US 5546282 A	13-08-1996	NONE	
EP 0330765 A	06-09-1989	US 4815104 A CA 1316233 A JP 2005377 A	21-03-1989 13-04-1993 10-01-1990
US 5233501 A	03-08-1993	NONE	
WO 9638884 A	05-12-1996	AU 2764695 A	18-12-1996